Listing of Claims

1. (original) A method of detecting a loss of integrity in a blood circuit supplying blood to a patient, comprising the steps of: detecting a leak in at least two independent ways to generate at least two leak detection signals; deriving at least one composite signal responsive to said two leak detection signals; generating an alarm signal responsively to said at least one composite signal.

2. (original) A method as in claim 1, wherein said step of deriving includes calculating a probability of a leak responsively to said at least two detection signals.

3. (original) A method as in claim 1, wherein said step of deriving includes combining said at least two leak detection signals such that a sensitivity of detection of a leak is enhanced.

4. (original) A method as in claim 3, wherein said step of calculating includes applying said leak detection signals to a network classifier.

5. (original) A method as in claim 1, wherein said step of deriving includes applying a respective weight to said at least two leak detection signals and adding them.

6. (original) A method as in claim 1, wherein said step of detecting includes sensing a presence of fluid outside said blood circuit and detecting a presence of air inside said blood circuit.

7-8. (canceled)

9. (original) A leak detection device, comprising: a first detector outputting a first detection signal; a second detector outputting a second detection signal; a signal combiner connected to form a combination signal responsive to both said first and second detection signals to generate an alarm output for connection to an alarm device; said signal combiner being such that both a sensitivity and a reliability of leak detection represented by said combination signal is greater than said first and second detection signals alone or together; said first detector being adapted to detect a first condition that is correlated with a leak in a blood circuit; said second detector being adapted to detect a second condition that is correlated with a leak in said blood circuit; said first and second conditions being associated with different physical phenomena.

10. (original) A detection device as in claim 9, wherein said combiner includes an analog summing circuit.

11. (original) A detection device as in claim 9, wherein said combiner includes a programmable processor.

12. (original) A detection device as in claim 9, wherein said first detector includes at least one of a detector of air in said blood circuit, a detector of fluid outside said blood circuit, a detector of pressure in said blood circuit, an image classifier connected to a camera oriented to image a patient, or a device to measure a patient heart rate, blood oxygen level, body weight, or the continuity or bioimpedance of tissue of the patient.

13. (original) A leak detection device for detecting a leak in an extracorporeal blood treatment machine, comprising: a first detector outputting a first detection signal; a second detector outputting a second detection signal; a signal combiner connected to form a combination signal responsive to both said first and second detection signals to generate an alarm output for connection to an alarm device; said first detector being adapted to detect a first condition that is correlated with a probability of a leak in a blood circuit; said second detector being adapted to detect a second condition that is correlated with a probability of a leak in said blood circuit.

14. (original) A detection device as in claim 9, wherein sa id first detector includes at least one of a detector of air in said blood circuit, a detector of fluid outside said blood circuit, a detector of pressure in said blood circuit, an image classifier connected to a camera oriented to image a patient, or a device to measure a patient heart rate, blood oxygen level, body weight, or the continuity or bioimpedance of tissue of the patient.

15. (original) A method of detecting an alarm condition in a medical treatment machine, comprising the steps of: combining detector signals from at least two indicators of an alarm condition such that a prediction of an alarm state is generated thereby and such that said prediction possesses at least one of a higher reliability and a higher sensitivity than said detectors signals uncombined; generating an alarm signal responsively to said prediction.

16. (original) A method as in claim 15, wherein said medical treatment machine is a blood processing machine and said alarm condition is a leak of fluid therefrom.

17. (original) A method as in claim 16, wherein said alarm condition is a leakage of blood from a blood circuit of said blood processing machine.

18. (original) A method as in claim 15, wherein said at least two different indicators of a status of a patient, medical treatment machine, or environment thereof.

19. (original) A method as in claim 18, wherein said different indicators include at least two of respective ones of a video image of a patient, a blood oxygen level of a patient, a body weight of a patient, a bioimpedance of a patient's tissue, a body temperature of a patient, a heart rate of a patient, a blood pressure of a patient, a breathing rate of a patient, a presence of fluid, and a presence of air in a fluid circuit.

20. (original) A method as in claim 15, wherein said step of combining includes deriving a probability of an alarm condition, said alarm signal indicating said probability.

21. (original) A method as in claim 15, wherein said step of combining has the effect of amplifying a reliability of an estimate of said alarm condition indicated by said signal relative to any one of said detector signals alone by cumulating influence of multiple detector signals to generate a linear or non-linear combination.

22. (original) A method as in claim 15, wherein said step of combining has the effect of amplifying a sensitivity of an estimate of said alarm condition indicated by said signal relative to any one of said detector signals alone by cumulating influence of multiple detector signals to generate a linear or non-linear combination.

23. (original) A method as in claim 22, wherein said step of combining also has the effect of amplifying a reliability of an estimate of said alarm condition indicated by said signal relative to any one of said detector signals alone by said cumulation of influence of multiple detector signals to generate a linear or nonlinear combination.

24. (original) A method as in claim 15, wherein said step of combining includes combining with a network classifier.

25. (original) A method of detecting a leak from a medical treatment machine, comprising: combining at least two respective ones of detector signals providing a video image of a patient, a blood oxygen level of a patient, a body weight of a patient, a

bioimpedance of a patient's tissue, a body temperature of a patient, a heart rate of a patient, a blood pressure of a patient, a breathing rate of a patient, a presence of fluid, and a presence of air in a fluid circuit; said step of combining being effective to yield a prediction of a leakage of fluid from said medical treatment machine.

26. (original) A method as in claim 25, wherein said step of combining includes deriving a probability of an alarm condition, said alarm signal indicating said probability.

27. (original) A method as in claim 25, wherein said step of combining has the effect of amplifying a reliability of an estimate of said alarm condition indicated by said signal relative to any one of said detector signals alone by cumulating influence of multiple detector signals to generate a linear or non-linear combination.

28. (original) A method as in claim 25, wherein said step of combining has the effect of amplifying a sensitivity of an estimate of said alarm condition indicated by said signal relative to any one of said detector signals alone by cumulating influence of multiple detector signals to generate a linear or non-linear combination.

29. (original) A method as in claim 25, wherein said step of combining also has the effect of amplifying a reliability of an estimate of said alarm condition indicated by said signal relative to any one of said detector signals alone by said cumulation of influence of multiple detector signals to generate a linear or nonlinear combination.

30. (original) A method as in claim 29, wherein said step of combining includes combining with a network classifier.

31. (original) A method as in claim 25, wherein said step of combining includes combining with a network classifier.

32. (original) A method as in claim 25, wherein said medical treatment machine includes an extracorporeal blood circuit.

33. (original) A method as in claim 25, wherein said medical treatment machine includes a fluid circuit.

34. (original) A device for detecting an alarm condition in a medical treatment machine, comprising: a signal filter adapted to combine detector signals from at least two indicators of an alarm condition such that a prediction of an alarm state is generated thereby and such that said prediction possesses at least one of a higher reliability and a

higher sensitivity than said detectors signals uncombined; said signal filter being further adapted to generate an alarm signal responsive to said prediction.

35. (original) A device as in claim 34, wherein said medical treatment machine is a blood processing machine and said alarm condition is a leak of fluid therefrom.

36. (original) A device as in claim 35, wherein said alarm condition is a leakage of blood from a blood circuit of said blood processing machine.

37. (original) A device as in claim 34, wherein said at least two different indicators of a status of a patient, medical treatment machine, or environment thereof.

38. (original) A device as in claim 37, wherein said different indicators include at least two of respective ones of a video image of a patient, a blood oxygen level of a patient, a body weight of a patient, a bioimpedance of a patient's tissue, a body temperature of a patient, a heart rate of a patient, a blood pressure of a patient, a breathing rate of a patient, a presence of fluid, and a presence of air in a fluid circuit.

39. (original) A device as in claim 34, wherein said prediction includes a probability of an alarm condition, said alarm signal indicating said probability.

40. (original) A device as in claim 34, wherein said signal filter combines said detector signals by cumulating influences of multiple detector signals to generate a linear or non-linear combination thereof.

41. (original) A device as in claim 34, wherein said signal filter includes a network classifier.

42. (original) A device for detecting a leak from a medical treatment machine, comprising: a signal filter connected to combine at least two respective ones of detector signals providing a video image of a patient, a blood oxygen level of a patient, a body weight of a patient, a bioimpedance of a patient's tissue, a body temperature of a patient, a heart rate of a patient, a blood pressure of a patient, a breathing rate of a patient, a presence of fluid,-and a presence of air in a fluid circuit; said signal filter being configured such that a prediction of a leakage of fluid from said medical treatment machine is generated by combining said at least two.

43. (original) A device as in claim 42, wherein said prediction includes a probability of an alarm condition, said alarm signal indicating said probability.

44. (original) A device as in claim 42, said signal filter combines said detector signals by cumulating influences of multiple detector signals to generate a linear or nonlinear combination thereof.

45. (original) A device as in claim 44, wherein said signal filter includes a network classifier.

46. (original) A device as in claim 42, wherein said signal filter includes a network classifier.

47. (original) A device as in claim 42, wherein said medical treatment machine includes a fluid circuit.

48. (original) A device as in claim 42, wherein said medical treatment machine includes an extracorporeal blood circuit.

If the Examiner has any questions, the Examiner is invited to contact the undersigned directly at 202-416-5818.

Oct. 31, 2005

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